THE GLASS INDUSTRY

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PRECISE PRODUCT CONTROL AT OWENS-CORNING PLANT

Modern batch preparation and handling equipment at the Newark, Ohio, plant of the Owens-Corning Fiberglas Corporation insures uniform quality and maintains essential properties of the company's new and unusual glass products.

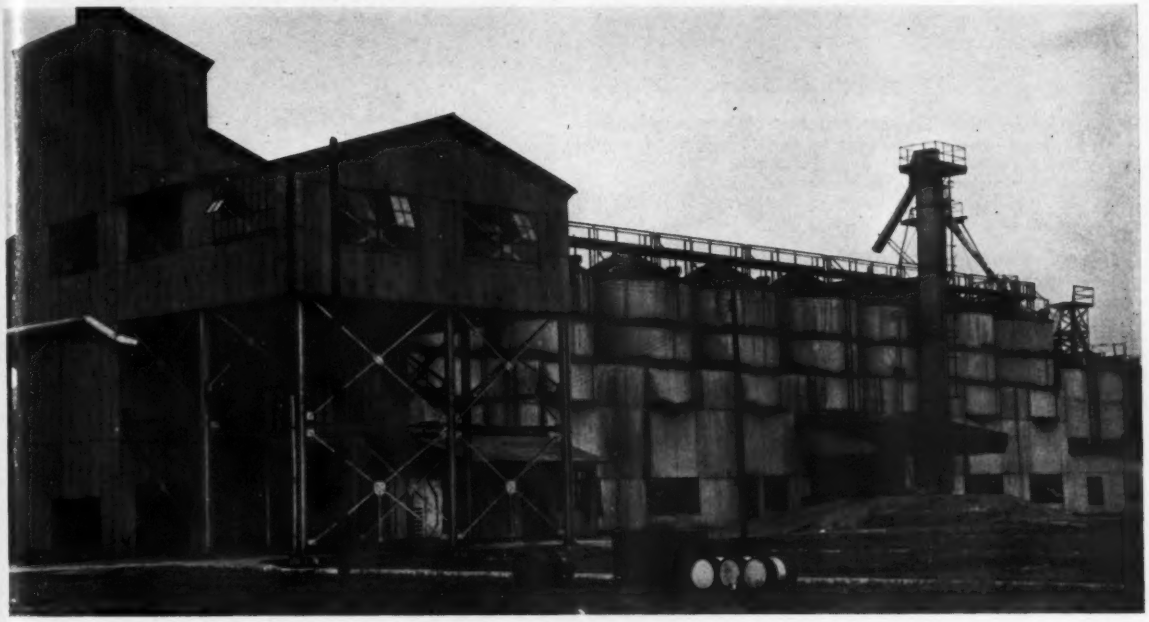


Fig. 1. This view of the batch plant of the Owens-Corning Fiberglas Corp. at Newark, Ohio, shows raw material bins at the right and the mixing house at the left.

The discovery and development of entirely new glass products and their utilization for applications in which other materials were hitherto employed is one of the outstanding achievements of the modern era, and these activites have proceeded to such an extent that our times are often designated The Glass Age. Whereas glass formerly served mankind mostly for windows and various kinds of containers, the average person of today is becoming more and more glass-conscious as the material touches his life at many new points through the mediums of architecture, science, art and industry. New uses for glass crowd upon one another, until it seems as though it might become almost a universal material.

To laymen and glassmen alike the new glass product now known under the trade-name of Fiberglas is one of the strangest and most exciting, both from the standpoint of the material itself and from its potential uses. In the field of textiles, air conditioning and heat insulation it is already fairly established; other possible uses are now undergoing trial and test; and possible applications for future utilization crop up almost daily. All of this seems to point to an enormous demand for Fiberglas and its products and an immediate increase in the productive capacity required. But in most of the proposed applications the new products must make their way against more-or-less established materials, including various vegetable fibers, asbestos, "rock wool" and almost every other kind of natural or synthetic fiber on earth. Fortunately for the glass industry, glass fibers can be made with properties that meet the requirements of any special application exactly and the uniformity and quality of the product can be controlled accurately at all stages of manufacture. Herein lies one of the big advantages of Fiberglas, since the properties of other materials, particularly the natural vegetable and mineral fibers, are not amenable to any such control.

Pioneers in the American development and manufacture of fiber glass were the Owens-Illinois Glass Co. and Corning Glass Works and the operations of both companies were recently combined in the Owens-Corning Fiberglas Corporation, whose manufacturing and research activities are located in the former Owens-Illinois

Fig. 2. From incoming cars raw materials are unloaded and elevated to the storage bins by this Stephens-Adamson traveling elevator. Note the Pangborn dust collector mounted on the elevator framework near the bottom.

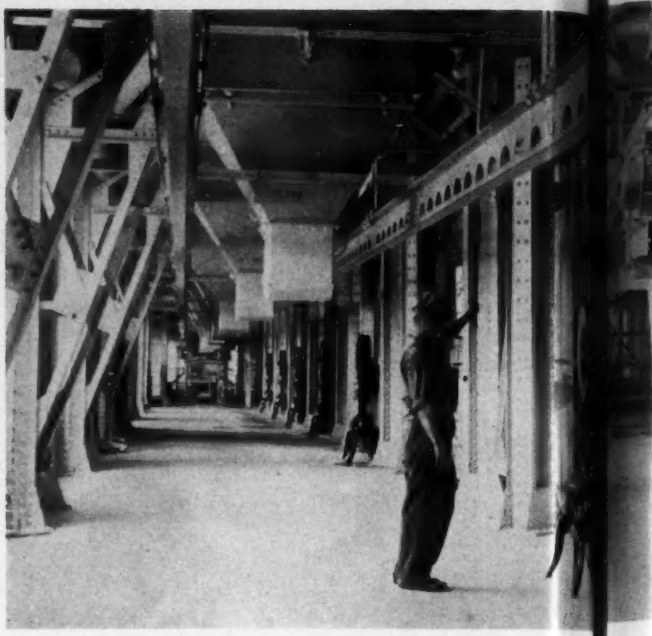


Fig. 3. In the gallery beneath the storage bins are located the weigh hoppers and scales for the different ingredients that make up the Fiberglas batch. Here the operator is manipulating the bin gate to draw the proper amount of material into the weigh hopper. The Toledo Scales are of the printing type.

plant in Newark, Ohio. From the very first it was recognized that the exploitation of Fiberglas in an established competitive market would require special glasses with certain definite properties, and that means for the exact control of these properties under commercial manufacturing conditions were necessary. Furthermore, such control would have to be exercised in such a way that the resulting cost would permit the new products to find their place in the established price structure of the market.

Both of these requirements can be satisfied only by a batch preparation department in which the proportioning of the raw materials is precise and in which the transportation system will function rapidly and economically without segregation of the ingredients before they reach the melting furnace. In the Owens-Corning batch house the desired objectives have been obtained, the properties and quality of its products being subject to a nicety of control that is utterly impossible in the processing of natural fiber materials. Inspection of the methods and equipment at Newark reveals a carefully planned and smooth-running batch system of the one-man type.

The main batch house, in which the functions of storage, weighing, collecting and mixing are performed, is shown in Fig. 1. The eight large tanks, or bins, for the storage of raw materials appear at the right, the weighing and collecting gallery being at the ground-floor level beneath the bins. The mixer is mounted on a steel framework in the tall building at the left, the center line of the mixer being about fifteen feet above the ground floor. The mixer discharges into a unit batch container in a position on the floor just inside the open door at the left and the loaded can is then raised to the upper floor of the building, the level of which can be identified by the windows and the steel-supported extension. At this level the loaded can is transferred to a tramrail which loops around the extension and passes along the rear of the furnace building above the furnace-charging floor.

The photograph on the cover of this issue shows the batch plant from the opposite side, together with the rear end of the tank building. The mixing building is located beyond the farther stack and the tramrail gallery passes along behind the upper row of windows in the furnace building, the lower row of windows indicating the charging-floor level. The whole layout is of interest to plant engineers, because it illustrates how modern materials-handling machinery can be adapted to serve furnaces on a higher level than the collecting and mixing equipment, without the use of continuously-running elevators or conveyors. This system utilizes unit containers for batch at all stages from the raw material bins to the melting furnace, the transfer from collecting car to mixer, from mixer to batch can, and from batch can to furnace being accomplished with comparatively short chutes.

Bulk raw materials are transferred from incoming cars to the storage bins by the Stephens-Adamson traveling elevator shown in Fig. 2, this view being taken from the upper floor of the mixing building. The elevator framework is supported on a monorail located parallel to the building and its upper portion is guided by a horizontal rail attached near the top of the storage bins. A motor drive moves the structure along the monorail and the discharge chute from the top of the elevator can be spotted to empty into any one of the eight bins as desired. A short belt conveyor is pivoted near the bottom of the elevator and bridges the space between car door and elevator boot.

The cars are unloaded into the conveyor hopper by a power shovel, the motors for driving both the shovel and the elevator proper being located in a housing just above the level of the upper guide rail. The belt con-

Fig. 4. After the materials are in the weigh hoppers they are collected in a Cleveland Tramrail gathering car. The car is then run down to the far end of the gallery where the minor ingredients are dumped in.

veyor has a width of 18 in. and is mounted on 7-ft. centers. Near the bottom of the elevator framework a Pangborn dust collector, complete with motor-driven fan, is also mounted. The main elevator is of the bucket type on 55-ft. centers and runs at about 160 ft. per minute with a capacity of approximately 8 tons per hour.

The eight storage bins are of riveted steel construction supported on heavy steel framework. They are 18 ft. in diameter by 18 ft. high and are fitted with discharge gates that are manually operated from the weighing floor. Two bins are reserved for sand and one each for limestone, dolomite lime, soda ash, feldspar, aplite, and borax. Minor batch ingredients are stored and weighed in a small building near the bottom of the first large storage bin.

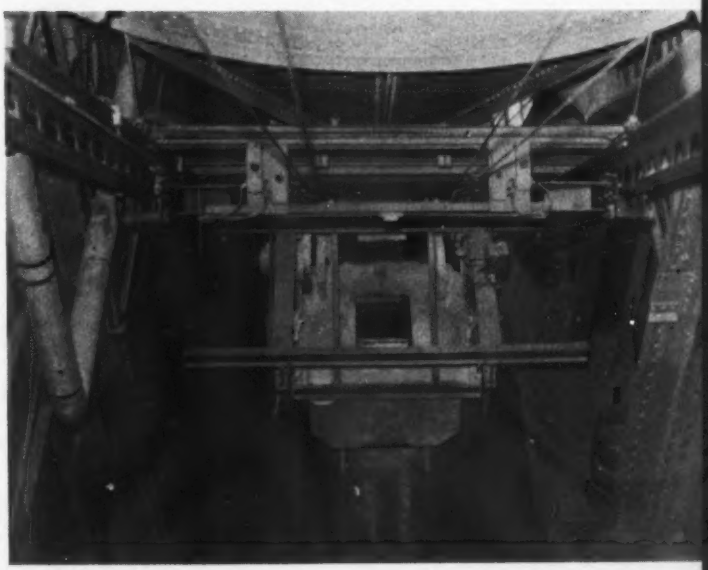
Beneath the discharge gate of each bin a weigh hopper is supported on the beam system of a Toledo scale, the dial instruments of the scales being located on the floor at one side of the weighing and collecting gallery, as shown in Fig. 3. Each scale has a capacity of 2,000 lb. and is furnished with a recording mechanism that is actuated by a push button and prints the actual weight of the particular ingredient on a tape. In Fig. 4 the operator is shown as he fills the Aplite weigh hopper with the proper amount of material by manipulating the bin gate. As soon as the proper amount is indicated on the dial he will push the button at the right of the dial and the actual weight will be recorded automatically.

Weighing accuracy is one of the fundamental requirements for exact control of product quality and uniformity and this weighing equipment has given excellent results. The scales themselves are checked periodically for accuracy and the element of human error is largely obviated by the printed record. It is apparent that the proper amounts of the various ingredients can be deposited in the weigh hoppers with a very small error and it only remains to mix the ingredients thoroughly and transport them to the furnace without segregation.

From the time it leaves the weigh hopper until it enters the charging hopper at the furnace the batch is transported on a semi-automatic tramrail system installed by the Cleveland Tramrail Division of the Cleveland Crane & Engineering Co. The first part of this system is the gathering or collecting car, shown in Fig. 4 at the dolomite lime position. The car is simply a large hopper in a framework supported by motor-driven trucks that travel on two parallel tramrails. A platform for the operator is provided and the car can be quickly positioned under each weigh hopper by means of the convenient controller handle. The weigh hopper gate is opened by means of the hand lever, as shown in the photograph, and the operation is repeated at each station until the entire 3,300 pounds of batch has been collected in the car. The car is then run to the end of the track near the mixer, where the minor ingredients are weighed out in pails and dumped into the hopper. Fig. 4 also shows the dust boot above the weigh hopper and the pipes by which it is connected to a large Pangborn central dust-collecting system.

As stated before, the mixer is located on a platform some 15 ft. above the floor, so the collected batch must now be raised to the mixer. This is accomplished by carrying the batch car up bodily on a sort of automatic skip hoist, the tracks for which rise toward the mixer at an angle of about 45 degrees and extend on through the upper floor. The last section of the horizontal tramrail in the weigh gallery is mounted on the hoist frame and Fig. 5 is a view taken from above showing the hoist and batch car ready to be raised to the mixer level. The hoist motors are located at the top of the shaft and drag the hoist up the incline by means of cables.

Fig. 5. This is a view from above looking down the hoisting tramrail by which the gathering car is raised to dumping position over the mixer. See also Fig. 6.



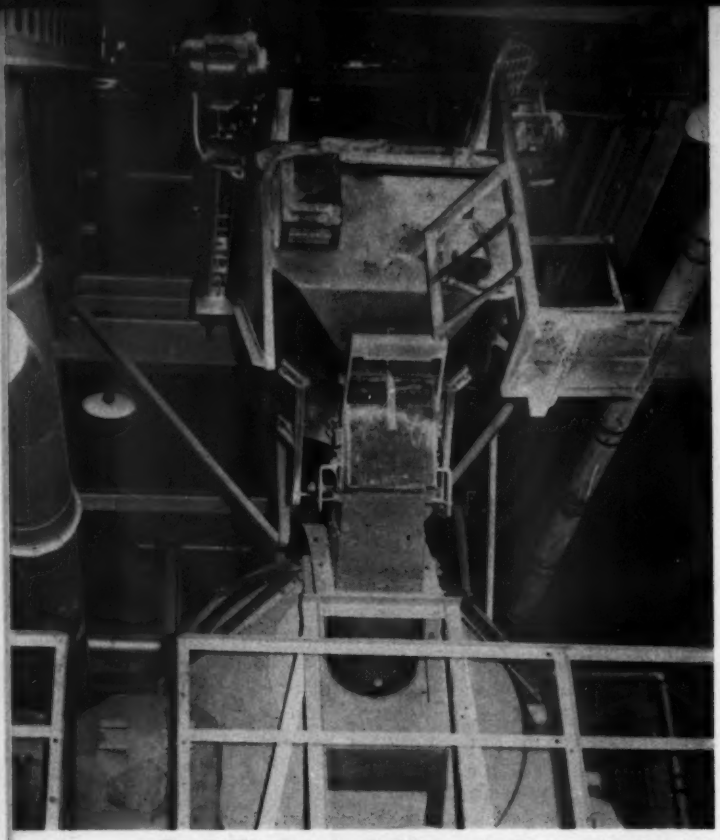


Fig. 6. This is a view looking up in the opposite direction from Fig. 5, and shows the hoist at the upper limit of its travel with the batch car in discharge position at the end of the T. L. Smith mixer.

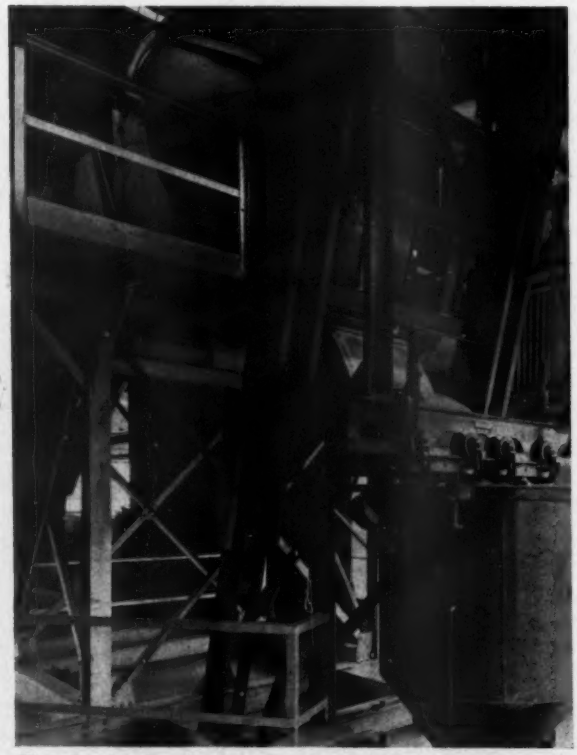


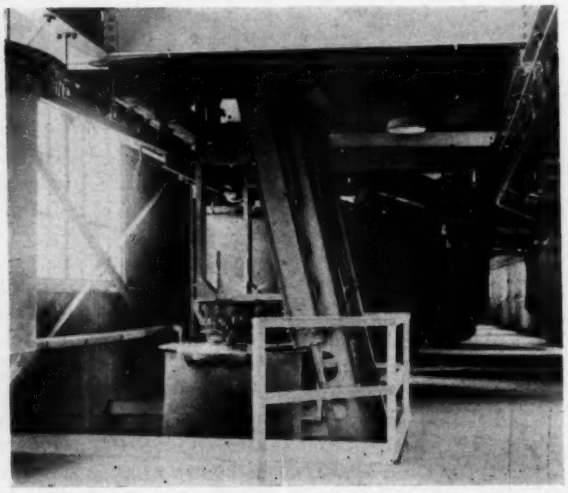
Fig. 7. At the discharge end of the Smith mixer the mixed batch flows through a short chute into a unit batch can carried on the framework of an automatic tramrail hoist. After the mixer has been dumped and returned to its horizontal position the hoist automatically raises the loaded batch can to the upper floor of the mixing house.

The upward motion of the hoist is started when the operator depresses a push-button and the succeeding movements of the hoist are automatic until it again reaches the bottom and stops. The batch car is first raised to its discharge position at the mixer, its discharge gate being opened automatically as it reaches the proper position. At the discharge position a relay causes the car to remain for a specified length of time, after which the hoist automatically lowers the car to the starting position. Fig. 6 is a view taken from below showing the batch car discharging its 3,300-lb. load into the mixer. During the period of batch mixing the operator goes down through the gallery weighing the required amounts of raw materials into the hoppers in readiness for the collection of the next batch.

At the end of the mixing period, which is regularly about 1½ minutes, the mixer is dumped by means of a manually operated crank in the weigh gallery. The mixer was furnished by the T. L. Smith Co. and is completely fitted with dust seals at both charging and discharging openings. The size of the mixer is No. 40S and it is driven continuously by a 30-h.p. motor. The mixed batch is discharged into a unit batch can through a short chute and the return of the mixer to the horizontal position automatically starts a train of events in which the loaded can is raised to the upper floor of the mixing house and an empty can is brought down to the filling position at the side of the mixer.

The raising and lowering of the unit batch cans is accomplished by another automatic skip-hoist, the tracks for which rise at an angle of about 80 degrees. The hoist frame carries a section of tramrail that fits into the tramrail system of the upper floor when the hoist is in the upper position. The can is suspended from the tramrail section by two four-wheel trucks, as shown in Fig. 7, in which view the hoist is at the bottom point of its travel and ready to receive its load of mixed batch from the mixer above. The batch can has a hinged cover and, as it reaches the position shown, the cover is auto-

Fig. 8. The batch can is here shown rising through the upper floor. When the short section of tramrail reaches its top position near the window the loaded can will automatically roll off into a tramrail loop at the left and an empty can will be fed to the hoist which will then descend to the loading position at the mixer.



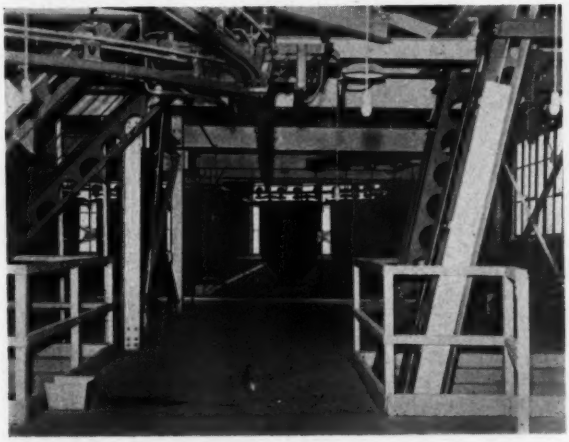
matically raised and the end of the chute is positioned over the can opening in such a way as to prevent the emission of dust.

The return of the mixer to its horizontal position starts the hoist motor through a limit switch and the hoist immediately rises, the chute being withdrawn and the can cover closed as the motion starts. Fig. 8 shows the loaded batch can rising through the upper floor and also the open section of the tramrail, in front of the window, which will be filled by the section of rail on the hoist when the hoist reaches the upper limit of its travel and automatically stops. As the hoist comes to rest the stops holding the can on the rail section are released and the can rolls off by gravity to the adjacent tramrail loop at the far left in the picture.

As the loaded can rolls off the hoist it operates a limit switch that starts a mechanism to position another empty can on the hoist. This mechanism consists of a length of wire cable running over two sheaves and carrying dogs which make contact with the trucks of one of the empty cans on the tramrail beyond the hoist frame in Fig. 8, in which view one of the sheaves and the cable can also be seen. As soon as the empty can is in position on the hoist the cable stops and reverses, moving the dog back to the next empty can which has meanwhile rolled down against a stop. At this point the mechanism again stops and remains at rest until the next loaded can has been brought up from below. The movement of the empty can into position on the hoist trips a limit switch, thus starting the hoist motor, and the can is carried down to its loading position where it remains at rest until the next mixer load has been dumped and the mixer returned to its horizontal operating position.

All of the switches and relays for the two hoists are mounted on a panel on the upper floor. It can be seen that the only manual control necessary for the raising and lowering action of both hoists is the push-button operation to start the upward movement of the batch

Fig. 9. At the left is the tramrail for the batch car hoist and that for the batch cans rises through the floor at the right. In the background can be seen loaded batch cans on the tramrail loop which enters the main line through the switch in the upper foreground.



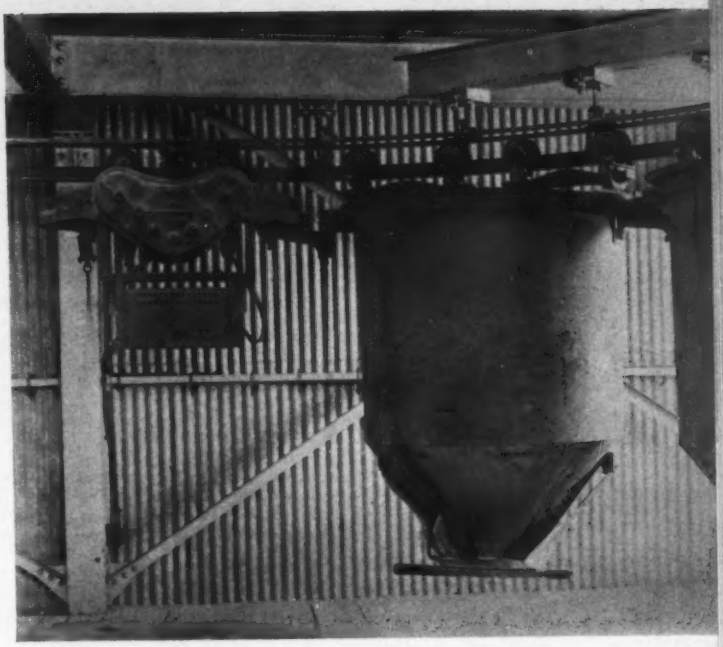


Fig. 10. Here is the electric tramrail tractor and the first two cars of its five-car train. Note the bumpers on tractor and cans and the swinging drawbars by which the train is connected together.

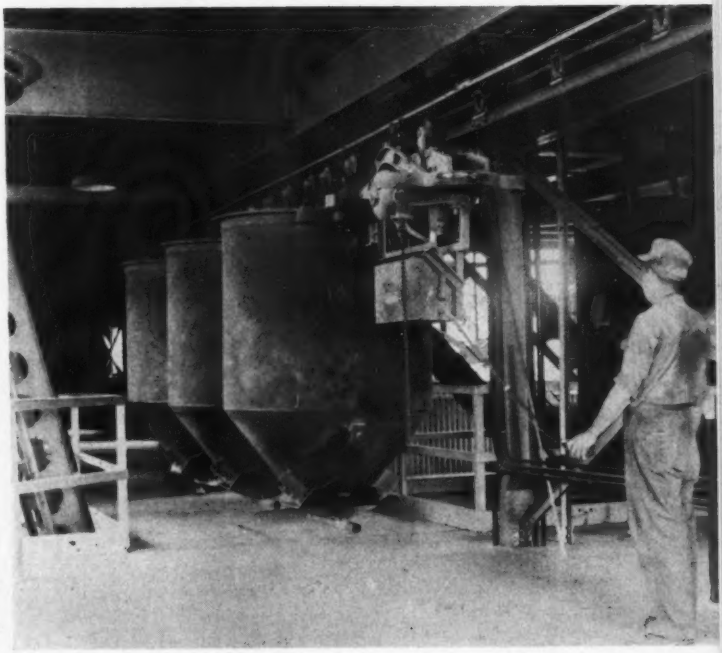


Fig. 11. The operator controls the tractor movement by means of a push-button switch which he carries in his hand. This train is being switched out of the loop into the main tramrail line leading to the furnace building.

Fig. 12. This is the tramrail gallery at the rear of the furnace building above the tank charging floor. Loaded batch cans are stored on the line at the right and empty cans return to the mixing house hoist on the line at the left.

car hoist and the operation of the crank to dump the mixer and return it to its operating position. The automatic control for any of the hoist functions can be disconnected, however, thus making it possible to control all movements by push button when desired.

As mentioned previously, the loaded batch can rolls by gravity from the hoist into a tramrail loop, a portion of this loop being shown in Fig. 9. In this view the top of the batch-can hoist is at the right, the top of the batch-collecting car hoist is at the left, and loaded batch cans can be seen on the tramrail loop in the background. The loop continues around the room and enters the main tramrail line to the tank building through the switch in the upper foreground of the picture.

While in the loop the loaded batch cans are connected into a five-car train and an electric tractor is coupled to the head end, as shown in Fig. 10. The tractor secures its power from trolley wires mount-on either side of the tramrail and its movements are controlled by means of a push-button box which is carried by the operator as he walks along beside the train. Both the tractor and the batch cans are fitted with bumpers, and swinging drawbars with spring-pins are also provided to connect the train together. Fig. 11 shows the tractor pulling a train of loaded cans through the switch into the main tramrail line. As soon as the last can has cleared, the switch will be thrown and the tractor will push the train down the gallery leading to the furnace building.

In the gallery there are two tramrail lines connected at intervals by crossovers and switches, as illustrated in Fig. 12. Here the loaded batch cans at the right have been pushed into the gallery from the mixing building and remain on the tramrail until their contents are required for charging one of the tanks. Empty cans return to the mixing house on the tramrail at the left, from which they are loaded on the hoist in succession by the automatic cable feeder.

At each tank position, of which there are five in this installation, a stub switch at right angles to the gallery line passes over and above the charging hopper for the tank. As shown in Fig. 13, the loaded batch can is centered over the hopper, the bottom gate in the can is opened, and the batch flows into the hopper as fast as it is used from below until the can is emptied. By keeping the hopper full continuously there is a minimum amount of segregation during this transfer from the can to the charging hopper.

Fig. 14 is a view on the charging floor below the tramrail gallery showing the doghouse at the rear of one of the melting tanks. The bottom of the hopper into which the batch can discharges can be seen at the top of the picture, together with the chute through which

Fig. 13. Stub switches carry the cans of batch out of the gallery at each furnace position and the batch flows into a hopper located above the rear end of the tank.

Fig. 14. This view shows the chute that leads the batch from the hopper into the doghouse, the amount of flow being controlled by a gate. Here is shown also the only practicable method found for charging the wooly cullet into the tank for remelting—with a pitchfork.

the batch flows by gravity to the furnace. The flow of batch is regulated as required by a manually-operated gate in the chute.

In the manufacture of fiber glass the amount of cullet produced is only from five to ten per cent of the total production, most of which is in the form of fluffy bunches of fiber, as shown in Fig. 14. Various methods for making this unusual type of cullet easily available for remelting have been tried and discarded and the only practicable method is still to tuck the woolly stuff into the furnace with a pitchfork as the operator in this picture is doing. At any rate, the crushing, handling and storage of cullet is not much of a problem at the Owens-Corning plant.

The outstanding problem is the maintenance of absolute uniformity in the product through control of the batching operations, and such control has been secured through the methods and equipment described above. A considerable expense was involved in the construction of this batch plant, but the operation and maintenance costs are comparatively low and the management is convinced that the means are justified by the results obtained under severe service conditions. For many glass products such uniformity in quality and properties is not an absolute necessity, but as glass finds more and more uses in the industrial and scientific field, the methods and equipment utilized in the Owens-Corning plant must receive careful consideration by every glass manufacturer.

BURST TEST DATA ON LAMINATED GLASS

W. R. Koch, assistant physicist and E. J. Wyrostek, junior engineering aid, at Wright Field, Dayton, Ohio, presented a paper on burst test data on laminated glass before the 42nd annual meeting of the American Society for Testing Materials on June 28th. Because of its possible interest to glassmen, a brief summary of this paper follows:

The use of pressure cabins in aircraft for the stratosphere has necessitated a study of the physical properties of laminated glass over a wide range of temperatures. Burst tests of rectangular plates clamped on all four edges were conducted by means of differential air pressure. The laminated glass used consisted of drawn glass, polished plate glass, heat-treated glass and combination polished plate and heat-treated glass, of various sizes and thicknesses. The plastics used in laminating included acetate, acrylate, and vinyl resins.

All types of laminated glass were found to require higher burst pressures at temperatures near —30 deg. C. than at those near 20 deg. C. The data indicate that rectangular plates are stronger in burst than square plates of the same area. For an area of one square foot a plate having a length-side ratio of four will resist burst at a pressure about twice that which causes fracture of a square plate of the same area. The burst strength of laminated combination glass is essentially the same as that of laminated heat-treated glass. The burst resistance of each of these types is about three times that of laminated polished plate glass. The deflection at the mid-point of laminated polished plate for a given pressure is slightly more than that of either laminated heat-treated glass or laminated combination glass for the same thickness. The deflections of laminated glass containing acrylate or vinyl resin are considerably greater than those containing acetate plastic. The burst pressure data on the glass containing the various plastics do not indicate outstanding burst characteristics for any one particular type of plastic. The data for various sizes do not give the same order of preference and conclusive results can only be obtained from a more extended investigation.

The rate of application of air pressure is an important factor in the results of burst tests. Although in general the rate was varied in such a way as to result in the total time of each test being of approximately the same period, variations in the rate of loading were used on identical glass specimens. The results of these tests indicated that glass is more resistant to burst pressures which are applied rapidly than to constant pressures or to those applied slowly. In the extreme case of a constant low pressure maintained until fracture occurred the necessity for the use of a high factor of safety was demonstrated. In some cases glass under constant pressure fractured after a few minutes at a pressure one-third of that necessary in burst tests conducted in the usual manner. Since a time test at constant pressure simulates the actual use in aircraft it is concluded that such tests are the most significant type for this purpose.

Scatterability characteristics of the glass under burst or impact are also significant and the unobstructed view of the pilot is a primary consideration in all cases. Because of spalling within the glass it is desirable to limit the thickness of the surface glasses to less than one-quarter inch. Glass fractured at pressures less than 25 lbs. per sq. in. is usually satisfactory from the standpoint of scatterability. Although vision is somewhat impaired by laminated plate and thin laminated heat-treated glass after fracture due to pressure, it should be emphasized that laminated combination and laminated heat-treated glass of more than one-quarter inch thickness becomes practically opaque after fracture.

PRODUCTION FIGURES FOR THE GLASS INDUSTRY DURING JUNE, 1939

Window Glass: During June, 1939, the production of window glass was 720,227 boxes, which represents 44.3 per cent of industry capacity. As compared with this, June, 1938, production was 344,456 boxes, representing 21.3 per cent of industry capacity.

Glass Containers: Production of glass containers during June, 1939, was 4,662,438 gross, bringing the 1939 total to 24,336,753 gross. Shipments during June were 4,617,822 gross, bringing the 1939 total to 23,792,373 gross.

Plate Glass: The total production of polished plate glass by member companies of the Plate Glass Manufacturers of America during June, 1939, was 9,288,788 sq. ft. as compared to 8,035,832 sq. ft. produced in the preceding month, May, 1939, and 5,956,386 sq. ft. produced in June, 1938. This makes a total of 58,757,436 sq. ft. produced during the first six months of 1939.

RECENT ORGANIZATION CHANGES AT CORNING GLASS WORKS

Recently announced personnel changes at Corning Glass Works include the formation of a new Bulb and Tubing Division, the naming of a comptroller and promotions in the Pyrex Houseware and Industrial Divisions.

The manufacture and sale of bulbs and tubing has now been segregated in a Bulb and Tube Division under G. W. Cole, vice-president, thus bringing under one head all of the bulb and tubing activities. The newly appointed general manager of the division is Justin J. Pfeiffer, who will be in charge of both manufacture and sales, reporting to Vice-President Cole. Mr. Pfeiffer is a graduate of the University of Michigan and came to Corning Glass in 1928 as a salesman of bulbs and tubing, being promoted to assistant manager of sales in 1930. In 1936 he was appointed manager of bulb and tubing sales, the position he occupied at the time of his recent promotion.

In charge of the manufacturing activities of the new division as Production Manager will be John W. Romig, his responsibilities including the manufacturing facilities at the Wellsboro, Fall Brook (Corning) and Rhode Island (Central Falls) plants. Mr. Romig received his M.E. degree from the University of Illinois and was formerly with the Owens-Illinois Glass Co. He joined the plant engineering department at Corning in 1929 and was transferred to the mechanical development department in 1931. In 1934 he became manager of the Wellsboro plant, becoming production manager of the fibre products plant in 1935 and production manager at the Rhode Island plant in 1938. Mr. Romig's position as production manager at the Rhode Island plant will now be taken by John J. Conway, formerly plant superintendent at Rhode Island.

The sales activities of the new Bulb and Tubing Division will henceforth be under the direction of Ernest F. Ling, formerly assistant manager of bulb and tubing sales. Mr. Ling graduated from Allegheny College in 1916 and received his M.A. degree from Cornell in 1920. His first job at Corning Glass was as a physicist in the laboratory, from which he transferred to the production department in 1923 and later became production manager of the Fall Brook plant in 1930. After a three-year period in the production department at the main plant, beginning in 1933, Mr. Ling became a salesman of bulbs and tubing in 1936 and was promoted to assistant sales manager later in the same year.

The new comptroller and assistant to the president of Corning Glass Works is William C. Decker, who has been treasurer of the Company for the past several years. Mr. Decker, who graduated from the Harvard School of Business after receiving a degree of chemical engineer at Penn State and doing graduate work at Columbia, came to Corning Glass Works in 1930 after a period in the sales department of the Brown Company. Since 1930 Mr. Decker has been successively manager of the industrial sales division and manager of cost accounting and treasurer at Corning.

C. D. LaFollette has been promoted from manager of Pyrex houseware sales to the position of company treasurer formerly held by Mr. Decker. Mr. LaFollette was graduated from Wabash College, entered Harvard Graduate School of Business, where he was assistant dean from 1922 to 1925, and then became assistant to the president of the Bobbs-Merrill Co., book publishers in Indianapolis. He came to Corning Glass Works in 1929 as manager of Pyrex houseware sales.

Willard A. Kates, formerly sales manager for the industrial division, now acts as sales manager of Pyrex houseware sales. Mr. Kates, a graduate of the University of Wisconsin, came to Corning in 1922 as an engineer in the research laboratory, later becoming sales head of the industrial division. Succeeding Mr. Kates in his former position will be T. J. Thompson, formerly salesman in the industrial division. Mr. Thompson is a graduate of Iowa State College and came to Corning in 1937 from the Johns-Manville Sales Corp. of Chicago.

GLASS BUILDINGS DEDICATED AT SHEFFIELD

The new buildings of the Department of Glass Technology, Sheffield University, Sheffield, England, were formally opened on June 12th, with ceremonies conducted by the Right Honorable Lord Riverdale, K.B.E., Chairman of the Committee of the Privy Council for Scientific and Industrial Research. The new buildings, which are divided into various sections devoted to particular aspects of the study of glass, occupy a very attractive well-wooded site. One of the most interesting features of the building is the extensive use of glass wherever possible. Vitrolite, glass building blocks, a special type of Pyrex, Thermolux, armorplate glass and glass fiber for insulation are all utilized.

C. D. LaFollette

W. C. Decker

E. F. Ling

J. J. Pfeiffer

MELTING OF GLASS IN TANKS

• *From an Article in "Céramique, Verrerie, Emaillerie," September* 1938, *translated by Elsie A. Preston—The Editor.*

Glass melted in a tank is generally worked by machines, often automatic machines. While the skill of the workman operating by hand enabled him to correct certain occasional differences in the properties of the glass, the new conditions demand constancy of a much higher order. The requirements imposed on the finished product are increasing all the time; there is room, therefore, for a study of the influence of tank behavior and construction on the quality of the glass delivered to the machines. These peculiarities are not always measurable, and cannot be expressed quantitatively; it is consequently necessary to appreciate and discern the trend of the corrections to be eventually brought about.

One essential element is the atmosphere above the melt. Everyone recognizes that it plays an importnat part in the heat balance of the furnace; that is the reason why analyzing apparatus, with recorders, are increasing. Yet the influence of the firing conditions is not restricted to thermal efficiency, but has also a chemical effect on the glass.

Jebsen-Marwedel, who has made a special study of these questions, recognizes that these two effects are connected and difficult to separate. It is nearly impossible to deal with them separately. It is nowadays admitted that the fuel gases are used most efficiently with a slight excess of air, under careful control. If reducing conditions are necessary the thermal efficiency will be reduced. The melting proper, and refining, up to the point where scum disappears, should be carried out at the highest possible temperature; the burners are regulated accordingly.

The use of saltcake as a refining agent is very general in tanks (at least in Europe). It is well, therefore, to examine its behavior. Saltcake melts at 880° and decomposes above 1,200-1,220° C; in fact it is only dissociated with difficulty. On the other hand, the glass melt dissolves only about 1.7-2.0 per cent of sulphate. It is therefore necessary to decompose the salt by a chemical reducing agent if one wishes to avoid "salt water." For this purpose powdered charcoal or coke is added to the glass melt; the molten sulphate rising to the surface of the melt is decomposed to sulphite and oxygen. The atmosphere, therefore, plays an important role, transforming the salt into a material the glass can deal with.

If the atmosphere were oxidizing, the presence of salt water would be inevitable, and there would therefore take place a volatization of alkalis, slow and not accompanied by dissociation. A corrosive salt-water, apart from its other well-known inconveniences, dissolves lime, which passes into the state of the metasilicate. The neighboring glass, therefore, becomes poor in lime, it takes on different properties, and cords may result (Jebsen-Marwedel).

Under normal conditions, a certain amount of SO_3 remains in the glass in chemical fusion. It is only in the refining zone that decomposition into SO_2 and O_2 is accomplished at the surface of the glass, and even then, apparently only incompletely. It is clear that bubbles form at this stage.

An excess of carbon in the batch, or carbonic oxide in the atmosphere, produces a very disagreeable brownish color, which arises from sulphide produced in accordance with the equation $Na_2SO_4 + 4CaO = Na_2S + 4CO_2$.

Generally this appearance of sulphide is transient. The saltcake is a corrective, and acts as an oxidizing agent with sulphide. It is to be feared, nevertheless, that the sulphide may be picked up by a thermal current of the tank, and arrive in the working end before oxidation. Laboratory tests on very pure substances have shown that the yellow-brown tint of the glass calls for the presence of sulphur in a reducing medium; carbon alone does not give this coloration.

It is quite useful to keep track of the furnace atmosphere by analysis of the waste gases. In the hot end the inflow of gas and air is such that slight positive pressure exists. The gases are therefore not drawn into the furnace by the stack; it is on the contrary the hot checker chambers which force them to ascend. This excess of pressure is indicated by the "stings" which come from the openings. In the cool end of the tank (working end) one may have a slight excess or deficiency of pressure, but it is only a matter of a fraction of a millimeter of water which is involved.

Let us suppose that the furnace is everywhere under pressure; the gas space is full of gas. The working zone contains burned gases in which there is CO in appreciable quantities, even in the presence of oxygen, because the combustion is not complete unless the excess of O_2 is considerable, which is uneconomical and hardly practicable. Experience shows, furthermore, that if a burned gas contains the quantity of oxygen necessary for burning the residual carbon monoxide, this gas acts as a reducer and not as a neutral gas. In a furnace under pressure the glass surface exposed to the gases is greater than if there is a pressure deficiency in part of the tank. In this case a rather low proportion of CO (1 to 2 per cent, according to Jebsen-Marwedel), suffices to ensure the reduction of the saltcake.

In tanks operating in part with a deficiency of pressure, the sucking in of air gives oxygen contents exceeding 10 per cent as far as the center of the refining zone. At this point there is no longer any CO. If there is saltcake to be reduced, the CO content in the melting zone has to be higher.

In every case it is advisable to regulate each pair of burners separately (regenerative furnace). The amount of gas necessary to obtain the desired temperature hardly varies if the quality of the gas is itself constant. The admission of more or less air only permits regulation within rather narrow limits, but it gives the oxidizing or reducing character. It is in the neutral region, containing little O_2 and CO that the content of CO_2 is highest. If the burnt gases from a port have an abnormal composition after the burner has been adjusted,

it may be suspected that there are obstructions in the corresponding parts of the checker work.

To judge combustion intelligently, the knowledge of the CO alone is not enough, it is necessary to measure the CO_2 as well. As each pair of ports must be studied separately, in order to have a method without violent changes from one end to the other of the zone of heat, the control is rather exacting, and is only practicable with automatic apparatus. The determination of CO_2 can be replaced by the of O_2.

It is evident that the residue of sulphate in the glass varies rapidly with the character of the atmosphere, for the reaction $2SO_3 = 2SO_2 + O_2$ rapidly reaches its equilibrium. In an oxidizing atmosphere with 2 per cent O_2 we find in the glass up to 1 per cent SO_3, and half that amount in a reducing atmosphere. It is evident that the 0.5 per cent difference is divided among the various constituents, and modifies the properties of the glass sufficiently to affect the work of the machines.

The addition of powdered coal in a batch containing sulphate must be gauged correctly. Salts which do not react rapidly with silica, and are not completely soluble in glass, produce gall; it is a matter, in practice, of sulphates of soda, potash, lime and sodium chloride, in so far as the latter is not volatilized. Small quantities of sulphate reduce themselves or react without the intervention of carbon in the batch. In basins fed with saltcake at Na_2SO_4, analyses of gall have given up to 96 per cent of this material, in other cases the content falls to 56 per cent, the other elements being principally $CaSO_4$ and insoluble matter.

If the sulphate does not decompose during the first stages of the fusion of the mixture it melts "as is," and its destruction becomes difficult. At this moment there practically is nothing left of the reducing fire which could burn off the gall. One can throw pieces of wood on to the surface of the glass, but this procedure is rarely applied in tank operation. When there is a considerable accumulation of gall it is necessary to skim with ladles, well dried and previously heated. Sometimes the gall spreads over a considerable area in a somewhat homogeneous fashion; correction is extremely difficult.

The necessity of avoiding too rapid wear of the tank limits the temperature of the melt to 1,450° C, or thereabouts. It is in the fining zone that this maximum is reached. Heating is more energetic in the neighborhood of the doghouse, but the feeding in of the batch, and the endothermic nature of the melt reactions, hinder high temperatures. The refining operation requires rather a long time, for the chemical reactions which give off gases are far from being instantaneous (it is certain that these equilibria are not completely attained, reboiling or late-forming bubbles prove the fact), and the formation of bubbles with sufficient ascending ability is pretty slow. Furthermore, the ascent of bubbles in the glass may be counteracted by the currents.

It is a well-known fact that glass does not flow uniformly from its entry into the doghouse to the point of working. Currents of thermal origin have components much more powerful than those of the working currents. The elements of the melt follow complicated trajectories, which depend on the geometry of the tank, on the distribution of temperatures and on other variable factors: composition and color of the glass, raw materials and the amount of moisture therein. It is thus very difficult to foretell, from knowing the dimensions of a tank, what will be the length of time a particle of glass will remain in the fining zone; this duration will not be equal for all the particles. The method of feeding into the furnace also plays a part; the large conical batch piles, whose origin in the tank is watched over by the chief operator, glaze over on the surface. Continuous feeding gives a better surface for attacking by hot gases, reduction per CO is facilitated. The problem of melting and refining is a complex one. It is advisable to maintain a steady régime as far as possible; that is an axiom of tank operation. This régime should be regular also, that is to say, should only give gradual temperature gradients, in order to limit the importance of thermal currents.

In addition, a high temperature must be maintained in the fining zone, in order to maintain a low viscosity to permit the giving off of gases. This giving off of gas occurs twice. At the time the melting of the mixture is accompanied by chemical reactions it produces a considerable emission of gas, of which the greater part escapes into the atmosphere. There are gases given off tardily and in small quantity, and also with much more difficulty, at the time of actual refining. The necessity of this refining modifies the construction and conduct of the furnace. In the fining chamber it is necessary to bring about a gentle and regular fall in temperature. In practice, the destruction of the sulphates is not complete; it would require an enormous amount of heat energy. The inevitable residue of SO_3 in the glass (0.4-0.7 per cent) does not detract from the quality.

The regularity of the temperature curve (down the center line of the tank) is modified by the local elements —ports and floaters. When it meets the floaters the glass has necessarily to submerge, in order to reappear on the far side. There is therefore, at this point, a reduction in temperature, compensated by what follows. Moreover, thermal currents may describe a transverse spiral, drawing the glass down into a relatively cool region, followed by ascent towards a warmer surface. To reduce this phenomenon to the minimum, the blocks of the side wall must not be excessively chilled. It is advisable also to avoid excessive local overheating.

The vaporization and scouring of the raw materials has not generally the importance attributed to it. It is notably so with alkaline vapors. The loss in silica partially compensates for the loss in alkali. Up to the present there have not been many numerical results published. Fine white deposits are found in the regenerators, white streaks at the doghouse and the working openings.

As regards the contributions by the refractories to the glass, calculations based on the results of prolonged tests indicate that the tanks give less alumina and iron oxide than pots. The oxidizing melts favor the increase of alumina, which increases the viscosity. If this aluminous glass is localized it easily causes cords. The corrosive element on the blocks is chiefly the free sulphate of soda, in a melted condition.

GLASS DIVISION FALL MEETING TO BE HELD AT SKYTOP

The 11th fall meeting of the Glass Division of the American Ceramic Society, to be held at Skytop Lodge, Skytop, Pa., September 8-10, promises to hold much interest to glassmen not only because of the practical nature of the papers to be presented but because of the natural beauty and opportunities for relaxation which Skytop offers.

Set between lakes and woods in the rolling Pocono Mountains, Skytop Lodge offers almost every sport a man could want. There is a sporty 18-hole, 6,400 yard golf course that has as much in the way of scenic beauty as golf. There is a lake for yachting and swimming and woods through which one may stroll or ride horseback. In addition, there is tennis, bowling, badminton, archery and fishing.

But more important than the vacation aspects of a visit to the meeting at Skytop are the group of papers which are scheduled for presentation to the Glass Division. From a study of the titles, it appears that the papers have not only scientific value but are eminently practical in nature as well.

On the morning of Friday, the eighth, there will be a symposium on glass defects at which the following papers will be read and discussed:

1. Some Inhomogeneities in Opaque (fluorine and sulphide) Glasses, by N. J. Kreidl, Dunkirk Glass Works, Dunkirk, N. Y.
2. Staining of Glass, Some Possibilities in the Study of Inhomogeneities, by W. Weyl, Department of Ceramics, Pennsylvania State College, State College, Pa., and J. C. Turnbull, Preston Laboratory, Butler, Pa.
3. Homogeneity of Optical Glass, by W. Fraser and Murray Scott, Bausch & Lomb Optical Co., Rochester, N. Y.
4. Glass Stones, by C. L. Thompson, Harbison-Walker Refractories Co., Pittsburgh, Pa.

Following a discussion of these papers, Louis Navias of the General Electric Co., will give a progress report on the activities of the A. S. T. M. Committee C-14 on glass and glass products. And that afternoon, G. E. F. Lundell of the National Bureau of Standards will lead a round table discussion on chemical analysis.

Saturday morning, the ninth, will be devoted to a symposium on the chemical durability of glass, with the following papers scheduled to be delivered:

1. pH Determinations as a Measure of Durability, by S. R. Scholes, Department of Glass Technology, New York State College of Ceramics, Alfred, N. Y.
2. Resistance of Glass Containers to Alcoholic Solutions, by Frank R. Bacon and O. G. Burch, Owens-Illinois Glass Co., Toledo, Ohio.
3. The Relations between Storage and Accelerated Chemical Durability Tests for Several Glass Compositions, by A. K. Lyle, Hartford-Empire Company, Hartford, Conn.
4. Some Observations on the Methods of Analysis Applicable to Solutions Obtained in Tests for Chemical Durability of Glass, by E. H. Hamilton, Donald Hubbard, and A. N. Finn, National Bureau of Standards, Washington, D. C.
5. Chemical Durability Requirements of Pharmaceutical Containers, by E. B. Carter, Abbott Laboratories, North Chicago, Illinois.

The afternoon will be devoted to a golf tournament and in the evening there will be an informal banquet and dance. In this connection, it should be mentioned that an interesting program of entertainment has been planned for the ladies.

THE GLASS INDUSTRY has been advised that hotel reservation blanks have been sent to members of the Glass Division. If the blank has not been received, reservation details may be obtained by writing Mr. Thornton Raney, Skytop Lodge, Skytop, Pa.

• Sixty-nine per cent of the total production of plate glass is utilized by the automotive industry, according to a recent report received from the Automobile Manufacturers Association. It is also interesting to note that 17 per cent of the steel produced, 40 per cent of the mohair produced in the United States, 35 per cent of the lead and a leading production of many other products went into cars and trucks.

Airplane view of Skytop Lodge where the Glass Division meeting will be held.

THE GLASS AGE

Reprinted from "The Architectural Review," February, 1939, and issued by Pilkington Brothers, Limited, St. Helens, England.

The title page of this short document says, "This is the first of a series of supplements each dealing with a different material. Emphasis is laid on decorative possibilities, but the supplements are also planned as a continuation of the special issues on materials that have been periodically published by *The Architectural Review* during recent years." The first of such pages of this *Review* illustrate a number of modern applications of glass for structural or decorative purposes, and this has followed the tradition of the recent book, "Glass in Architecture and Decoration," reviewed in THE GLASS INDUSTRY, November, 1938. These examples of the use of glass are on a moderate scale, varying from the decorations or illuminations of a single room to the design of a store front for a factory building.

The latter half of the *Review* consists of six reports of the Glass Age Town Planning Committee. "A Committee of architects was convened by Pilkington Brothers, Limited, and was asked to suggest solutions to certain problems of town planning in London, Edinburgh, Liverpool and Bournemouth. The terms of reference for the Committee were: 'Use all the structural and decorative resources of the Glass Age, but produce practical schemes that could actually be built.' An imaginative use of modern materials, rather than mere romantic fantasy was desired."

It is a little difficult to review the supposed solutions which are illustrated by perspective color drawings, usually two or three pages in width. In some cases the proposed solution is compared with an aerial photograph or a photograph from the top of a building, showing the present state of the area proposed for Town Planning. This presentation rather begs the whole issue. The question involved is not, whether the area can be redesigned to make it look better than the area as it appears at present, but whether the use of glass on a generous scale can make the area look better than a comparable area, otherwise well designed, but constructed of more conventional materials. Thus the proper comparison in the first report dealing with the re-designing of the Strand, London, should involve not the Strand as it stands at present, but, for instance, the area of government buildings in Washington, D. C., constructed very largely of stone.

Moscow is in process of being very largely reconstructed at the present time, and no doubt if a Communistic Government took possession of all private property in London, it might be possible to tear down the Strand and rebuild it as a unit on the lines suggested by the Town Planning Committee. It is further possible, of course, that the destruction of London by aerial bombing in the not distant future may create an opportunity to redesign the place more as a unit. However, it would seem more logical to suppose that in that case, more attention shall be given to bomb proofing than to designing tall and vulnerable buildings of glass. That London could be largely rebuilt with advantage, as it was rebuilt after the great fire will be conceded, and it is entirely possible that, given peace time conditions, a solution somewhat along the lines of the Town Planning Committee might some day become feasible. At the same time it is not entirely obvious that a case has been made out for the use of glass on a large scale in order to effect the fundamental purposes.

Somewhat similar comments apply to all the other designs and we feel that a great deal more work must be done with glass as an architectural medium on a small scale, before we can resort to Town Planning in terms of glass. Nonetheless the ideas are stimulating and we congratulate their authors.—F. W. P.

NEW MINERAL DISCOVERED

Discovery of a new mineral, officially named "*shortite*", has been announced by the Geological Survey, Department of the Interior. Composed of a double carbonate of sodium and calcium, the new mineral was found and identified by J. J. Fahey, chemist, in the Geological Survey laboratory. It was discovered as disseminated well-formed crystals in sections of core from the John Hay oil and gas well, drilled by Mountain Fuel Supply Company on leased Government land in Sweetwater County, Wyoming, at depths of 1,250 to 1,800 feet below the earth's surface. "*Shortite*" was named in honor of Dr. M. N. Short, former geologist of the Survey who now is Professor of Optical Mineralogy at the University of Arizona.

Although the commercial value of "*shortite*" is not yet definitely known, the new mineral is associated with considerable quantities of trona, sodium carbonate-bicarbonate, which does have potential commercial value. Trona was identified in a sample from this same well in 1938 by R. C. Wells, chief chemist of the Geological Survey.

Additional samples for further laboratory examination will be collected by Mr. Fahey who has left Washington, for the shortite-bearing area. It is expected that sections of core, two inches in diameter, and totaling a few hundred feet in length will be transported to Washington.

CORNING GLASS WORKS ANNOUNCES NEW LABORATORY BUILDING PLANS

Completion of plans to erect a new laboratory research building was announced recently by Corning Glass Works, the site of the projected construction being the space now occupied by buildings Nos. 1 and 2 at the main plant in Corning. The new building will have 42,500 square feet of floor space, the first floor being devoted to auxiliary production facilities related to A factory. The other four floors will be used for laboratory research. This new building was first planned in 1937, but construction activities were deferred.

The new building will permit the gathering of all the Corning laboratory research activities under one roof. For several years, as the laboratory staff and research program have expanded, it has been necessary to house the various activities in available parts of the plants and the company has had in mind the providing of a building with new modern facilities for the adequate advancement of the research program.

It is a matter of historical interest that the new building will occupy the site of the original building of the Corning Glass Works in Corning. This building was erected in 1868 when the plant first moved to its present location.

GLASS CENTRIFUGAL PUMP PERFECTED

A centrifugal pump for handling commercial quantities of corrosive acids and other chemical liquids has recently been developed successfully by Corning Glass Works in cooperation with the Nash Engineering Co., well-known pump manufacturer, who will market the new device. The parts of the new pump which come in contact with the flowing chemicals are made of hard Pyrex-brand glass and resist the action of these liquids, although many of the chemicals quickly destroy metal pipes and pumps. All acid solutions (except hydrofluoric and glacial phosphoric acids) can be handled without fear of corrosion or pitting.

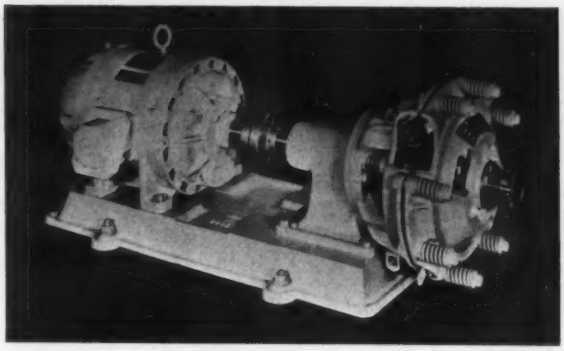
It is expected that the new glass pump will be very effective in reducing production costs in many chemical processes, since pump maintenance will be practically eliminated. Another valuable feature is the ease and facility with which the pump can be disassembled for thorough cleaning when necessary. The device may thus be kept free of minute traces of those corrosion impurities which might completely change chemical reactions and the properties of the resulting products. Pipes of glass have long been used to solve the problem of conveying corrosive liquids and the new pump marks a further step in the safe and economical handling of such materials.

The detailed construction of the new Nash-Corning pump are clearly shown in the accompanying illustrations from which it will be noted that the device consists of a glass impeller and a two-section glass casing, all mounted in a special metal housing. The complete assembly may be fixed on a baseplate and connected to the driving motor with a flexible coupling, as shown, or another arrangement in which the pump is attached directly to the motor frame with the impeller mounted directly on the motor shaft is also available.

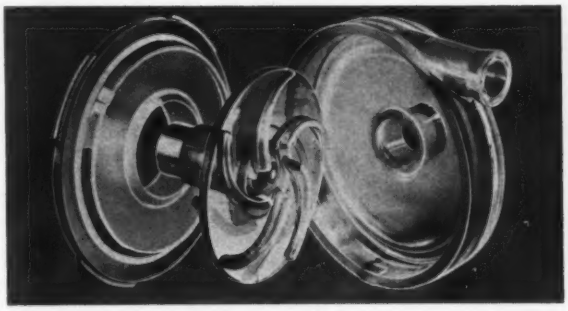
The manufacture of these pump parts on a commercial basis from hard corrosion-resisting glass represents quite a departure from usual glassware production, for the parts must not only be accurately molded but they must also be machined (ground) to give the close tolerances and small clearances necessary in the machine of which they are a part. Such glass production has been brought to high perfection by the Corning Industrial Division, whose glass piping and other types of chemical equipment are already well known.

The impeller with its vanes and hub is a single piece of pressed glass, the hub side and its vanes being formed in the body of the mold and the flat side of the disk with its vanes in the plunger. The hole in the hub is shaped by a withdrawable plug in the mold and is formed with splines molded in. When the impeller is assembled in the pump there is plenty of peripheral clearance, so no grinding is required on the edge of the disk, but the clearance between the vanes and the casing are held to normal pump clearances and the edges of the vanes must be ground very closely to size. Commercial grinding on both the impeller and the parts of the casing is accomplished by means of special accurate holding fixtures.

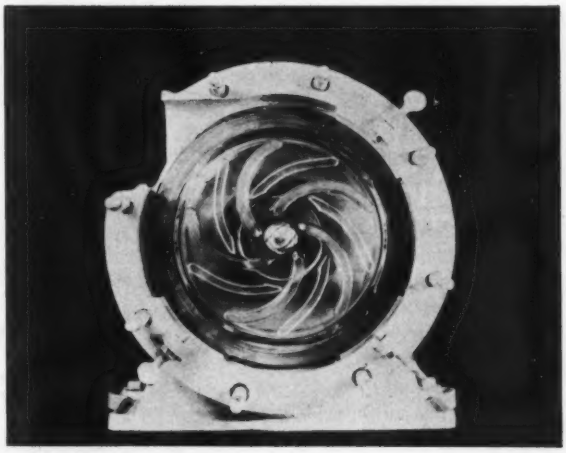
The impeller hub does not fit directly on the pump shaft, but is mounted and cemented on a splined quill or



The new Nash-Corning glass centrifugal pump mounted on a bedplate with its driving motor. The pump inlet is at the center of the casing with the outlet near the periphery at the top.



The glass parts of the new centrifugal pump for corrosive liquids include, from left to right, the outer casing section, the impeller and the inner casing. It will be noted that a metal quill is cemented into the hole in the glass impeller hub.



End view of the new glass pump with the outer casing removed, showing the impeller and the inner casing section mounted in its metal frame.

sleeve which is in turn carried on the shaft. The assembly of quill and impeller is dynamically balanced so that it will run without appreciable vibration at high speed.

One side of the casing is a flat disk with a center hole and does not provide much of a problem from the pressing standpoint. It is ground near the outer edge to provide a seat for the edge of the other half of the casing and also around the center hole to provide proper clearance for the edges of the vanes. The other section of the casing, however, presents a very difficult molding problem since it carries the inlet pipe at the center and the outlet pipe at the periphery. Both of these pipes are molded in one piece with the casing section, the holes also being formed by withdrawable plugs. The outer end of each pipe has the regular back taper which fits the standard connection fittings for glass pipe. This section of the casing is ground on the edge and on the inside face, another finishing operation being the drilling out of the inlet and outlet holes to remove the diaphragms left between the plugs and the plunger of the mold.

So clear is the glass used that the interior of the pump may be watched while in operation and it is easy to detect any unsatisfactory condition in the material being pumped or the necessity for cleaning. The pump readily handles 6,000 gallons of acid or other liquids per hour and will deliver the material to a head of 70 ft. above the suction level. Should cleaning be required, the whole interior of the pump can be laid open in a few minutes and reassembly after cleaning is also quickly accomplished, the proper adjustment of parts being practically automatic.

A.S.T.M. C-14 MEETS IN ATLANTIC CITY

The A.S.T.M. Committee C-14 on Glass and Glass Products met in Atlantic City June 27th for the purpose of hearing the reports of the several sub-committees.

Dr. G. E. F. Lundell, Chairman of Sub-Committee II on chemical analysis, reported on the activities of his group. The work on the standard glass sample No. 128 is to be continued. The future work will be concerned with the so-called rapid routine methods and it is hoped that sufficient progress will have been made by the fall that a progress report will be available in time for the Fall Meeting of the Glass Division. The work on the chemical analysis of glass sand has been completed and the tentative method has been accepted by the committee and will be voted upon by letter ballot by the members of C-14.

The report of Sub-Committee III on Chemical Properties, D. E. Sharp, Chairman, consisted of a sub-committee report by A. K. Lyle. This report dealt largely with recommendations for future work. It was recommended that further work on the powder method be discontinued so far as glass containers are concerned. It was also recommended that the autoclave tests and low temperature tests be repeated in order to iron out the apparent discrepancies in results and establish, if possible, the relation between time-temperature effects of the higher and lower temperatures. A new series of bottles representing a greater range of compositions will be used for this work.

Due to the increased use of applied color decorations on containers, it was decided that the problem of the chemical durability of such colors be investigated by this sub-committee. A sub-committee is being formed to take over this subject.

The report from Sub-Committee IV on Physical and Mechanical Properties, J. T. Little ton, Chairman ,consisted of the approval of three tentative methods dealing with the testing of glass containers. The methods are: 1—Polariscopic Examination; 2—Pressure Testing; 3—Thermal Shock Testing. These three methods will be sent to the members of C-14 for vote by letter ballot.

Sub-Committee VI on Glass Construction Block and Tile, J. P. Staples, Chairman, have been inactive due to the fact that research on the fundamentals is still in progress by the interested parties. When this work is finished this sub-committee will be in a better position to correlate the existing knowledge.

There were no reports from either Sub-Committee I on Nomenclature and Definitions or Sub-Committee V on Thermal Properties.

PENN STATE CERAMIC CURRICULUM

H. B. Northrup, director of the Mineral Industries Extension at the Pennsylvania State College, has announced the curriculum for the ceramics extension which consists of three years of work for which one text book has been prepared for each year. The first year consists of a general preparatory course covering fundamentals of mathematics, physics, chemistry, fuels and combustion. The second year of the curriculum deals with the geography, geology, mineralogy, extraction, preparation and benefication of all ceramic raw materials.

The two years work designated above are common to all ceramic extension students. During the third and final year of their studies, an option is available depending upon the particular industry in which the student is engaged. It is planned to have four termnial third year courses dealing with the following subjects for which a textbook will be prepared in each instance. They are: (a) Heavy Clay Products and Whitewares, (b) Refractories, (c) Glass, and (d) Enamels. Books (a) and (b) are in preparation. Book (a) is expected to be ready for third year classes starting next October and book (b) will be completed within the school year. Book (c) will not be prepared by this Division for the present but classes interested in glass will use a standard textbook, "Modern Glass Practice," by Dr. S. R. Scholes. Book (d) is scheduled for preparation by this Division.

All classes are organized on the basis of 120 hours per year. These classes meet usually two hours per night, two nights per week for 30 weeks. Students are awarded a certificate worth eight points toward an industrial diploma upon the completion of each year of the work. When the student has completed satisfactorily the three year curriculum in any extension work offered by this Division he is awarded an extension diploma.

The net annual cost per student per year in classes operated under public supervision and control is $2.50, which is the price of his textbook. In company operated classes, the cost will be, in addition, the pro-rated cost of the teacher's salary. The latter arrangement may be alleviated through company action and it has been found to be very encouraging if the company remit to the student all or part of his instruction cost if the student passes the course.

INVENTIONS AND INVENTORS

The present is a period of great patent activity. Inventions are developing rapidly in every field of glass making, as witness fiber glass, structural glass, safety glass. Despite this activity, THE GLASS INDUSTRY *has purposely avoided the field of patents as a regular feature of its reportorial service; to do otherwise, it seemed, would be a duplication of similar functions already being satisfactorily performed by the scientific societies.*

However, last January the anti-monopoly hearings brought interest in the subject to more than normal intensity. We began to sense anew something that had always bothered our sub-conscious: that the last word in a patent service had still to be spoken, and that we should speak that word. Our problem was to discover the proper formula.

The following summaries represent a new and novel type of information service on patents. Its objective is to present every two months a digest of the patents issued by the U. S. Patent Office, and to maintain a certain degree of informality in discussing the inventors and their inventions. We have selected a bi-monthly rather than a more frequent presentation in the belief that the bi-monthly presentation would have the advantage of indicating more clearly the type of problem which is being most intensively studied by the glass industry. It will be our object to point out industrial trends and activities and the extent to which they may be reflected by the issuance of patents.

There follows below a summary of patents issued in May and June.

We would welcome comments from readers on this new form of presentation for patents. Does it offer a useful service to you?—The Editor.

Raw Materials and Compositions

Two patents were issued concerning opacifying agents, primarily for ceramic glazes and enamels. Ludwig Weiss of Frankfort-on-the-Main, Germany, (Deutsche Gold und Silber Scheide-Anstat) patented (2,163,334) the use of a basic sulphate of cerium in conjunction with other basic silicates such as sodium silicate. Raymond W. Hannagen of Cardiff, Wales, claims in patent 2,163,516 that in the use of zinc sulphide as an opacifyer, improvement was obtained by introducing zinc oxide.

Furnace Equipment

Inventive features in patent 2,162,377 to Carroll Cone of Surface Combustion Corp., for a glass annealing lehr, include the placement of burners and the means of handling the combustion gases.

A second patent involving lehrs was 2,162,030 granted to Louis P. Piazzoli (Capstan Glass); an electric resistance element comprised of loops is mounted in the top of the lehr so as to radiate heat vertically up on the ware, and is so spaced as to provide more heat at the ends of the unit than in the middle.

A means for water cooling glass tank flux blocks at the metal line, patented by John H. McKelvey and John W. Rogers, was assigned to the Laclede-Christy Clay Products Co. (2,163,405).

Patent 2,164,071 granted to Don R. Limbers and assigned to the Pittsburgh Plate Glass Co. is concerned with the functioning of the drive on a lehr for annealing glass sheets.

Eugene C. Sullivan (Corning Glass) has been issued patent 2,162,983 concerning the construction and use of a glass melting tank. Air is forced through the bottom and side joints of the tank to prevent leakage of glass and to aid in fining and homogenizing the glass.

Dr. George V. McCauley, also of Corning, has patented (2,160,438) a ceramic mold suitable for use in casting massive glass bodies such as telescope disks. A principal difficulty with such molds when made of ordinary ceramic materials, is their tendency to give off bubbles when heated. Dr. McCauley's compositions are compounded from silica, alumina (not over 17 per cent) and soda ash, or other bond, and may be used to form the main body of the refractory mold, or merely to coat it.

Forming and Shaping

A patent (2,164,184) granted to Frank L. O. Wadsworth, deceased, covers an apparatus and method for severing and delivering a gob of glass. The method consists in moving a pair of shear blades in the direction of travel of the stream while closing the blades to sever the charge of glass, and continuing the movement of the blades to accelerate the delivery of the charge and at the same time to shape the upper end of the charge.

A patent to Alvie C. Crimmel of Hartford City, Ind., is concerned with apparatus for forming large masses of glassware. This involves means asociated with each of several fore-hearths for forming individual gobs which are automatically conveyed to a single common mold. Patent number 2,162,800.

Hartford-Empire was the assignee of George E. Howard's patent 2,161,255 for a machine for forming glassware.

A method for molding stemmed glassware in one piece is involved in patent 2,156,613 to Louie Wohinc, Weston, W. Va.

Glass Blocks

Two new Owens-Illinois patents affect glass blocks. Leonard D. Soubier's patent 2,164,093 covers a method of joining together the two pre-formed sections of a block. An apparatus brings the sections together after their edges have been submerged in molten metal and while they are being moved in molds at the discharge end of the forming machine. Patent 2,156,623 granted to Harold L. Eastus describes a hollow block having at least one side recessed for the retention of bonding mortar.

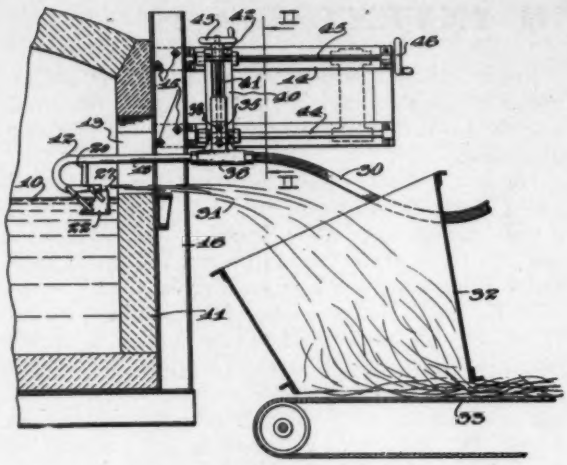
A patent to Corning Glass (Edward J. Winship, 2,162,987) covers a modified design of glass block and the wall assembly on which it is used.

Edwin E. Slick of Pittsburgh patented a hollow block wall construction of which only the exterior faces of the blocks are glass (2,163,454).

Glass Wool and Fiber

In this group three of the five patents issued were assigned to the Owens-Corning Fiberglas Corp. One of the

* Copies of these patents may be obtained from the Commissioner of Patents, Washington, D. C., by sending 10 cents and giving the patent number.



Glass fiber apparatus patented by Games Slayter and John H. Thomas (No. 2,156,316 to Owens-Corning Fiberglas Corp).

four (2,156,316 to Games Slayter and John H. Thomas) was concerned with the formation of glass fibers by a gas blast within the furnace which served to syphon the molten glass upward to a spout terminus from which it was blown into a collecting chamber by the blast. Patents 2,159,028 (to Cecil F. Johnson) and 2,159,053 (Arthur D. Saborsky) respectively cover a reinforced wool bat, and a means of using such a bat for insulating an enclosed chamber. The reinforcement prevents the crushing of the bat when it is pressed into place, frequently in a closely confined area.

The two additional inventions in this field were 2,156,982 granted to Charles G. Harford and Earl Stafford (Arthur D. Little Inc.) and 2,159,282 granted to Louis Marino of Kansas City, Mo. The Harford-Stafford patent is a method for spinning glass wool in a continuous process by which the threads are formed as the molten glass is thrown from a rapidly spinning disk. The Marino patent covers a bat-forming table.

Decoration

A transfer cylinder which has been successfully used in printing tumblers with ceramic colors was described in a patent (2,160,725) granted to Francis C. Flint of Hazel-Atlas Glass Co. Previously difficulties occurred with a transfer cylinder, using the ordinary rubber blanket from which the decorations were applied to the glass ware, because the blanket did not pick up enough ceramic paint from the inking rollers. In the solution of this problem covered by Mr. Flint's patent, the usual blanket is covered with a silk screen with the result that more ink is picked up. Another means of applying and fusing decorations to glass articles was covered by patent 2,162,317 granted to Anton G. Rez, of Seattle.

A decoration technique was also patented (2,160,560) by Frank D. Parkinson of Blackpool, England.

Anthony L. Normandi and Gemma Blanche Traversi (2,158,633) patented a novelty article, whereby a woman's figure (decoration) appears nude when viewed from one side of a tumbler and fully clothed from the other. The nude decoration is first baked on, and then the clothing is painted over it. Such articles have already been marketed widely.

Rowland D. Smith's patent 2,162,980 (Corning Glass) covers a method of coating glass articles with metal. The pre-heated glass is introduced into a pool of molten metal, whose melting point is above the annealing point of the glass but below 1500 deg. C. The glass is kept in the metal on the glass but not long enough to cause appreciable deformation.

Plate and Sheet Glass

As indicated by the eighteen patents issued to the Pittsburgh Plate Glass Co. in May and June, the development of new products, particularly laminated glass and new constructional materials, has introduced many problems which are still engaging the attention of engineers and technicians. Even the old problems of how to handle plate glass sheets have bobbed up again as a result of the particular shape and form of these new articles of glass. Three patents relating to these problems are 2,159,672 and 2,164,077, both granted to William Owen, and patent 2,156,876 to R. D. Russell Scull.

A group of patents covering laminated glass manufacture was issued to Pittsburgh Plate Glass No. 2,156,680 to Brook J. Dennison, details means of fabricating two sheets with a plastic bond, as do Russell G. Whittemore's patent 2,156,714, patent 2,159,630 which was granted to Elmer H. Hauz, and Earl L. Fix, and No. 2,156,688 to Frank W. Hall.

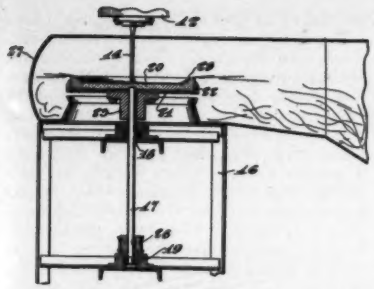
Refinements in the process of drawing continuous sheet for controlling the thickness of the rolled band at the edge of the sheet are covered by patent 2,157,759 which Andrew Jollie of St. Helens, England has assigned to the Pittsburgh Plate Glass Co.

This Company was also the assignee of patent 2,164,048 granted to Pierre Bertrand of Paris, France, which is concerned with an improved method of developing and controlling the edge of the glass sheet as it is being drawn vertically from the surface of the bath.

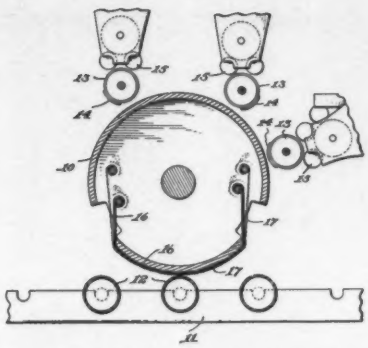
Three additional Pittsburgh Plate Glass Co. patents involve the polishing and surfacing of sheets and related apparatus. No. 2,156,686 (James Green) covers a polishing block to which a slurry of abrasive material is applied over a resilient base, 2,159,631 to John D. McLeod and Harry A. Reynolds is an apparatus for abrading the plaster from surfacing tables, and 2,156,699 to William Owen covers a surfacing table with a false top under which a cooling liquid can be circulated.

Patents assigned to Libbey-Owens-Ford Glass Co. involved (1) improved equipment processes for tempering glass sheets (2,160,065 to George R. Ford, Jr.), (2) for mounting sheets in plastic material upon work tables (2,160,033 to Edwin A. Rosin) (3) a glass edging machine (2,160,085) granted to William J. Robertson and (4) a means for mounting glass plate in sash or store front construction (2,163,845 to Clyde D. Lowry). Two additional Libbey-Owens-Ford patents were those granted to George B. Watkins. Patent 2,164,301 is described as a process of interposing a layer of synthetic resin plastic between two sheets of glass to form a sandwich. This is submitted first to a relatively high pressure and low temperature, then to a lower pressure but higher temperature. Mr. Watkin's patent 2,163,648 is concerned with the manufacture of laminated glass.

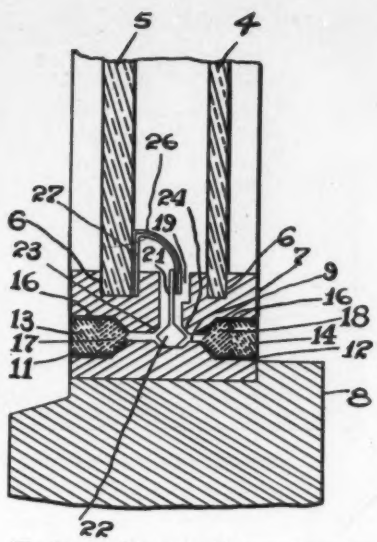
A patent to Walter O. Amsler (2,158,669, Frazier-Simplex, Inc.) proposes to eliminate eddy currents



The spin-throw fiber wool machine used by Charles G. Harford and Earl Stafford of Arthur D. Little, Inc. (U. S. Patent No. 2,156,982).



Francis C. Flint's improved apparatus (U. S. Patent No. 2,160,725, assigned to Hazel-Atlas) for printing designs on glassware. Item 17 is a silk screen mounted over the usual transfer blanket 16 so that it will absorb more ink from the plates 14.



The bi-metallic strip 26 operates valve 22 so as to close off the air from the warmer side of this double glass window; the purpose is to prevent the admission of moist hot air to the dead air space which would cloud vision by condensation (U. S. Patent No. 2,159,661 to P. E. Knudsen, Pittsburgh Plate Glass Co.).

(which form around the coolers and produce irregularitties in the glass sheet as it develops) by employing forced draft in an advantageous manner.

Three patents cover apparatus designed for cutting glass sheets. No. 2,158,900 was granted to Felix Goffaux (deceased) of Shreveport, La., and Nos. 2,156,864 and 2,156,847 were both assigned to the Pittsburgh Plate Glass Co.; the inventors were William Owen (whose five patents were the largest number granted to any single inventor for glass products or apparatus during May and June) and James Gregory respectively.

New Products and New Uses

New glass products or new uses were involved in patents for a starting box for racing greyhounds (2,164,213 to Hattie E. Levenson of Miami), a kitchen cabinet with part glass shelves to allow illumination from a single source, (2,157,264 Samuel B. Kirby, Jr., Louisville, Ky.), a patent to Josef Schlosinger (2,157,189) covering means of securing and sealing glass roof tiles, and two patents granted to Arthur H. Payson and Chas. O. Duevel Jr. (American Thermos Bottle Co.) for improved glass vacuum vessels, 2,163,056 and 2,163,057.

Other patents in this miscellaneous group included a laboratory funnel containing a porous insert (2,160,571) to Harry C. Bates, Corning Glass, a vanity mirror having a simulated bevel 2,162,590 to James L. Richter of Far Rockaway, N. Y., a modified rear-vision mirror and visor assembly for automobiles (2,163,495) to Solomon M. Levy of Los Angeles, and a composite shatter proof window glass (2,162,598) to Harry N. Atwood of South Lyndeboro, N. H. The latter consists of interwoven glass ribbons encased in transparent plastic material coalesced by heat and pressure.

Bernard Long of Paris, France patented (2,156,457) a multicellular or bubble glass, in which the bubbles are produced by the use of a powdered reducing metal such as aluminum, together with titanium oxide or other dissociable metallic oxides.

Percy E. Knudsen's patent 2,159,661 (Pittsburgh Plate Glass Co.) is a double glazed window with a means for preventing the deposition of moisture on the inside surfaces. This is accomplished by a valve operated by a bi-metallic thermal strip (see illustration) so as to have the dead air space always in communication with the air from whichever side of the window is the cooler.

No. 2,159,673 also assigned to Pittsburgh Plate Glass (William Owen, inventor) covers a sash construction for a glass store front.

Four patents covered new uses for glass fiber. No. 2,158,337 to Olaf Rasmussen (General Motors Corp.) claims the use of glass fiber in a friction brake so as to frictionally engage the braking member. The three remaining patents in this group were assigned to the Owens-Corning Fiberglas Corp. No. 2,160,003 (Games Slayter and Jan S. Irvine) is an air filtering unit filled with glass fiber; 2,160,009 granted to John E. Walker claims a means for covering pipe with an insulating cover containing glass fiber, and 2,160,001 granted to Arthur D. Saborsky covers an improved insulation of the panel type.

The well known property of "tempered glass" of shattering completely whenever any fracture occurs, has been put to practical use by William O. Lytle of the Pittsburgh Plate Glass Co. In patent 2,159,665 he covers the use of plates of this glass as shingles. With ordinary glass, the occasional breakage of shingles left the stub intact and caused the expenditure of much labor in making repairs.

New types of bottle closures were disclosed in the four following patents: 2,161,097 to Thorolf Schroder-Nielsen of Horton, Norway; 2,162,068 to Edith and Charles Duell of Hartford, Conn.; 2,162,092 to Carl E. Lundgren of La Porte, Ind.; and 2,162,182 to Williard B. Smith of Vancouver.

Hans Pulfrich of Berlin-Friedenar, Germany patented (and assigned to General Electric Co.) three types of ceramic-to-metal seals. These are patents 2,163,407 to 2,163,409.

Members of the Optical Institute, Inc. —from left to right: S. C. Hirschberg, American Spectacle Co.; F. E. Camp, Willson Products, Inc.; A. O. Boniface, Sun Glass Institute; Harry Richards, Foster-Grant Co., Inc.; D. P. Bernheim, American Optical Co.; W. J. Parfrey, Spill Mfg. Co., Inc.; C. S. Frey, L. J. Houze Convex Glass Co.; C. H. Gallaway, American Optical Co.; A. R. Grossman, Optical Products Corp. of N. Y.; J. Chester Crowther, Bachmann Bros., Inc.; Roger J. Houze, L. J. Houze Convex Glass Co.; F. J. Koeth, Bausch & Lomb Optical Co.; C. P. Sutton, L. J. Houze Convex Glass Co.; Charles Board, L. J. Houze Convex Glass Co.; Joe Brunetti, Columbia Protektosite Co., Inc.; Ted Levitt, Midland Optical Products Co.; Ray Simon, Midland Optical Products Co.; Chas. E. Hart, American Optical Co.; T. A. Willson, Willson Products, Inc.

SUN GLASS STANDARDS ADOPTED

The proposed commercial standard for ground-and-polished lenses for sun glass, submitted by the Sun Glass Institute, Inc., were adopted at the general conference held by the National Bureau of Standards in Atlantic City, June 16th. The purpose of this commercial standard is to provide a nationally recognized specification for ground-and-polished sun glass lenses to serve as assurance and protection to purchasers; to promote fair competition between manufacturers; and to serve as a basis for certification of quality.

The specification covers all types of ground-and-polished sun glass lenses made entirely of glass. And the standard covers the accuracy of grinding and polishing as well as freedom from defects that impair serviceability of ground-and-polished glass lenses. Certain specific requirements and certain testing methods and equipment have been specied. Those manufacturers, who meet the requirements, will be given a certification of quality indicating that their product has met the requirements of the Bureau of Standards.

A. C. S. SCHEDULES FALL MEETINGS

Five divisions of the American Ceramic Society are planning to hold Fall meetings. The Art Division will meet in Blue Ridge, N. C., August 17-18. The Enamel, Porcelain Enamel Forum will meet in Columbus, October 18-20, and the Refractories Division at the Oakland Beach Hotel, Conneaut Lake, Pa., September 8-9. The White Wares and Materials and Equipment Divisions will meet together at the Summit Hotel, Uniontown, Pa., September 15-16. The program of the Glass Division meeting to be held in Skytop, Pa., September 8-10, is presented in full elsewhere in this issue of THE GLASS INDUSTRY.

$1,700,000 MODERNIZATION PROGRAM

A $1,700,000 modernization program for the Pittsburgh Plate Glass Company No. 4 works at Ford City, Pa., has been announced by H. S. Wherrett, president. "The project," Mr. Wherrett said, "involves a reconstruction of nearly half the furnace capacity of the plant. A portion of the pot furnaces will be replaced with a new continuous tank and lehr, similar to the one recently installed at the company's Crystal City, Mo., plant. The modernization program also involves a revision of batch handling equipment at the plant. Construction work is to begin immediately."

• Edward Hald, president of the Orrefors Glass Works, has been elected an honorary member of the English Royal Society and has received the title of Royal Designer of Industry. Only four foreigners are reported to have been thus honored. Many of Mr. Hald's pieces are included in the extensive Orrefors display at the Swedish Pavilion at the New York World's Fair.

MAY TAX LABOR-SAVING MACHINERY

The Senate and the House of Representatives have directed the Secretary of the Treasury to conduct an investigation of the desirability and practicality of imposing a tax on the use of labor-saving and labor-displacing machinery. The conclusions derived from this investigation are to be presented to Congress at the beginnings of the second sessions of the 67th Congress.

SAN FRANCISCO MEETING OF A. C. S.

As has previously been reported in THE GLASS INDUSTRY, the Golden Gate meeting of the American Ceramic Society is scheduled to be held in San Francisco, Monday through Friday, August 7-11. In addition to offering an excellent opportunity to visit the beautiful Golden Gate Exposition in San Francisco Harbor, many papers of unusual worth are scheduled to be read at the Technical Sessions. Of particular interest to glassmen is the paper on "Spectral Transmission of Some Inorganic and Organic Glasses Containing Carbon in the Visible and Near Infrared," by Willi M. Cohn of the University of California Extension Division. Professor Cohn prepared glasses of the formula 1.0 Na_2O — 2.0 SiO_2. Various types of graphite, sugar coal, charcoal, bone black and lampblack were added to the batches. The color of the glasses, caused by these additions and by various thermal treatments was studied. X-ray tests were carried out in an attempt to establish a correlation between the crystalline structure and the coloring action of additions. Data are presented on the spectral transmission from 3,600 to 10,000 Å of inorganic glasses of different thermal history.

CURRENT PRICES OF GLASS-MAKING MATERIALS

FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS

Base Materials

		Carlots	Less Carlots
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	43.00	46.00
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point	ton	15.00-16.00	18.00
Borax ($Na_2B_4O_7 10H_2O$)	lb.	....	....
Granulated	In bags, lb.	.0215	.027 -.0295
Powdered	In bags, lb.	.024	.0295-.032
Boric acid (H_3BO_3) granulated	In bags, lb.	.048	.054 -.0565
Calcium phosphate ($Ca_3(PO_4)_2$)	lb.	.07	.07½
Cryolite ($Na_3Al\ F_6$) Natural Greenland (Kryolith)	lb.	.0865-.0875	.0925
Synthetic (Artificial)	lb.	.0825	.0875
Feldspar—			
20 mesh	ton	11.00-13.25	
40 mesh	ton	11.50-13.75	
Granular	ton	11.75-14.00	
Semi-granular	ton	11.00-13.25	
L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags			
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2, 2½%)			
Bulk, carloads, f. o. b. mines	ton	29.00	....
In bags	ton	30.60	40.00-42.00
Kryolith (see Cryolite)			
Lead Oxide (Pb_3O_4) (red lead) (N. Y.)	lb.	.0725-.0735	....
In 5 Ton lots	lb.	....	.0775
Less than 5 Tons	lb.	....	.0825
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	8.50	8.50
Burnt (CaO) ground, in bulk	ton	7.00	....
Burnt, ground, in paper sacks	ton	9.00	9.00
Burnt, ground, in 180 lb. drums	Per drum	1.60	1.70
Kiln Dried ($CaCO_3$) 10x30 mesh	ton	1.75	....
Kiln Dried ($CaCO_3$) 16x120 mesh	ton	1.75	....
Nepheline Syenite, f. o. b. shipping point	ton	12.00-14.00	....
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.065	.0675
Hydrated 80-85%	lb.	.055	.0575
Salt cake, glassmakers (Na_2SO_4)	ton	15.00	25.00
Soda ash (Na_2CO_3) dense, 58%—			
Bulk	Flat Per 100 lb.	.95	....
In barrels	Per 100 lb.	1.35	....
In bags	Per 100 lb.	1.10	....
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	Per 100 lb.	....	2.50-2.90
95% and 97%			
Bulk	Per 100 lb.	1.35	....
200 lb. bags		1.415	1.44
100 lb. bags		1.45	1.475

Special Materials

		Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)	lb.	.029	.03½
Aluminum oxide (Al_2O_3)	lb.	.07	.09
Antimony oxide (Sb_2O_3)	lb.	.10½	.11¼
Arsenic trioxide (As_2O_3) (dense white) 99%	lb.	.03	.03½
Barium nitrate ($Ba(NO_3)_2$)	lb.	....	.07¾
Pyrophyllite, (20% Al_2O_3)	ton	9.00	12.00
Sodium fluosilicate (Na_2SiF_6)	lb.	.035-.04	.04¼-.05
Tin Oxide (SnO_2) in bbls.	lb.	....	.52
Titanium Oxide (ceramic grade)			
In bags	lb.	.12	.12¼-.12¾
In barrels	lb.	.12-.12¼	.12½-.13
Zinc Oxide (ZnO)			
American process, Bags	lb.	.06¼	.06½
White Seal, 150 lb. bbls.	lb.	.08¾	.09
Green Seal bags	lb.	.08	.08¼
Domestic White Seal bags	lb.	.08½	.08¾
Red Seal, bags	lb.	.07½	.07¾
Zircon			
Refined Granular (Milled .01-.02c higher)		.06½	.07-.08
Commercial, Gran. (Milled .01¼-.01½ higher)		.0275	.0325

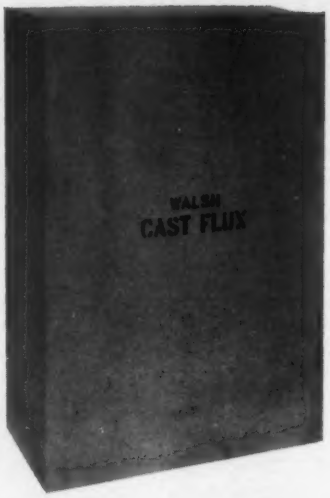
Coloring Materials

		Carlots	Less Carlots
Barium selenite ($BaSeO_3$)	lb.	....	1.40-1.60
(Commercial. 25% Selenium)	lb.	....	.85
Cadmium sulphide (CdS)	lb.	....	70-.75
Chromite (99% through 200 mesh)	ton	35.50	40.00
Chromite ore (air floated)	ton	55.00	58.00-73.00
Cerium hydrate—			
100 lb. drums and 600 lb. barrels	lb.	....	.60
Chrome Oxide Green. 400 lb. bbls.	lb.	....	.22-.26
Cobalt oxide (Co_2O_3)			
In bbls. 350 lbs. or more,	lb.	....	1.67
Less than 350 lbs.,	lb.	....	1.77
Copper oxide—			
Red (Cu_2O)	lb.	....	.165
Black (CuO)	lb.	....	.16-.17
Black prepared	lb.	....	.22
Iron Oxide—			
Red (Fe_2O_3)	lb.	....	.0425-.09
Black (Fe_3O_4)	lb.	.04½	.09
Iron Chromate	lb.	....	.035-.05
Lead Chromate ($PbCrO_4$) in bbls.	lb.	....	.145
Manganese, Black Oxide			
In Paper bags	ton	47.50	50.50-54.50
In Burlap bags	ton	49.25	51.75-56.75
In Casks	ton	51.50	54.00-59.00
Neodymium oxalate, 50 lb. drums	lb.	....	3.50
Nickel oxide (Ni_2O_3), black	lb.	....	.35-.40
Nickel monoxide (NiO), green	lb.	....	.35-.37
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb	.08¾	.09-.09¼
Powdered	lb.	....	.09¼-.09¾
Potassium Chromate (K_2CrO_4) 100 lb. kegs	lb.	....	.27
Powder blue	lb.	....	.17-.2125
Rare earth hydrate—			
100 lb. drums	lb.	....	.35
325 lb. barrels	lb.	....	.30
Selenium (Se) In 100 lb. lots	lb.	....	1.75
In lesser quantities	lb.	....	1.85
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06¾	.07-.07¼
Sodium chromate (Na_2CrO_4) Anhydrous	lb.	.08¼	.08¾-.08½
Sodium selenite (Na_2SeO_3)	lb.	....	1.50-1.65.
Sodium uranate (Na_2UO_4) Orange	lb.	....	1.75-1.80
Yellow	lb.	....	1.75-1.80
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.35	3.70-4.10
Flowers, in bags	Per 100 lb.	3.00	3.35-3.75
Flour, heavy, in 250 lb. bbls.	Per 100 lb.	2.90	3.25-3.65
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots. Black	lb.	....	2.65-2.75
Yellow orange	lb.	....	1.75-1.80

Polishing Materials

		Carlots	Less Carlots
Emery, Turkish	lb.	.063	.07
Pumice Stone,			
American Ground Italian FFF, FF, F	lb.	....	.03
0, 0½, ½, 1	lb.	....	.03¾
Putty Powder	lb.	....	.38-.42
Rotten Stone, (Domestic)	lb.	....	.02
Rouge, Red	lb.	....	.14
Black	lb.	....	.16

WALSH CAST-FLUX



The Vacuum-cast flux block of superior quality.

Walsh Cast-Flux blocks are machine-trued to exact size and shape after burning.

THEY LAST LONGER

The excellent results obtained in numerous tanks melting various types of glass has definitely established the efficiency and economy of Walsh Cast-Flux blocks.

Walsh Cast-Flux has a dense, uniform structure; it is burned at higher temperatures, is thoroughly bonded and possesses a low coefficient of expansion.

Walsh Cast-Flux blocks meet the most rigid requirements for tanks operating at higher temperatures . . . they insure greater tonnage, higher quality glass, freedom from defects, longer life and maximum economy.

WALSH REFRACTORIES CORPORATION

Manufacturers of Refractories for the glass industry for over 50 years

4428 North First Street
St. Louis Missouri

ALTEN'S Heat-Treated PLUNGERS

Dense Structure
Ready Machinability
Longer Wear

ALTEN'S

Foundry and Machine Works
LANCASTER, OHIO

FOR BETTER GLASS
AT
LOWER COST
INSTALL TANK FURNACES
USING
ANY FUEL
Designed and Built by
FORTER-TEICHMANN CO.
119 Federal Street Pittsburgh, Pa.
Cable Address "Forter"

ISCO CHEMICALS

ISCO CARBONATE OF POTASH

Dustless Calcined 98/100%
Hydrated 83/85%

ISCO CAUSTIC POTASH

Granular 90/92%

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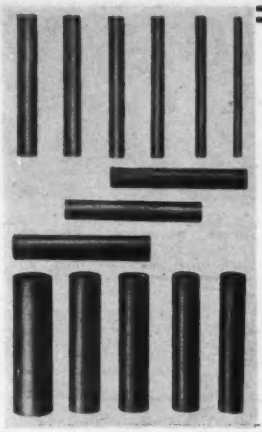

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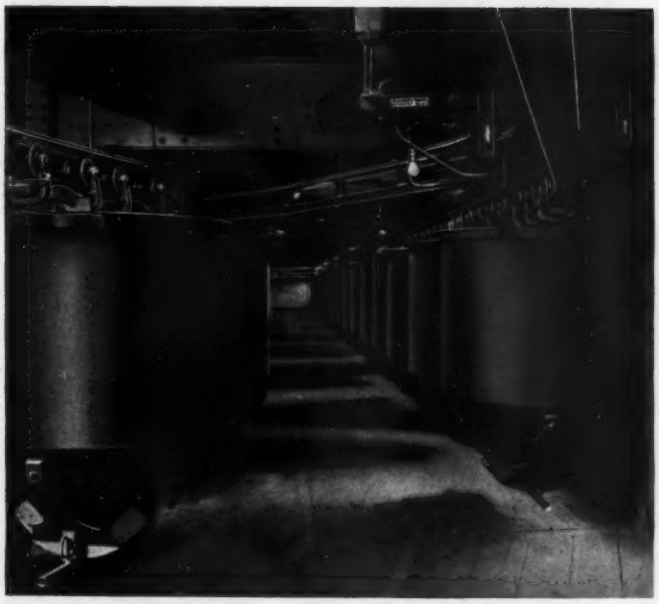

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